Sustainable Taro Culture in the Pacific

The Farmers' Wisdom

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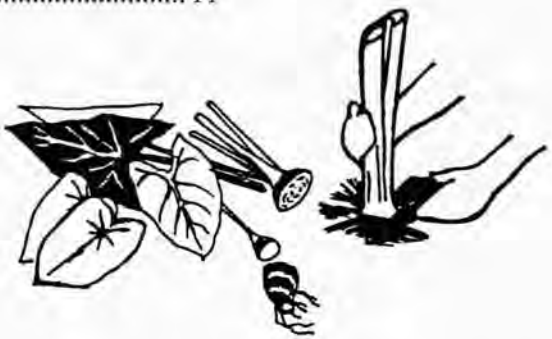


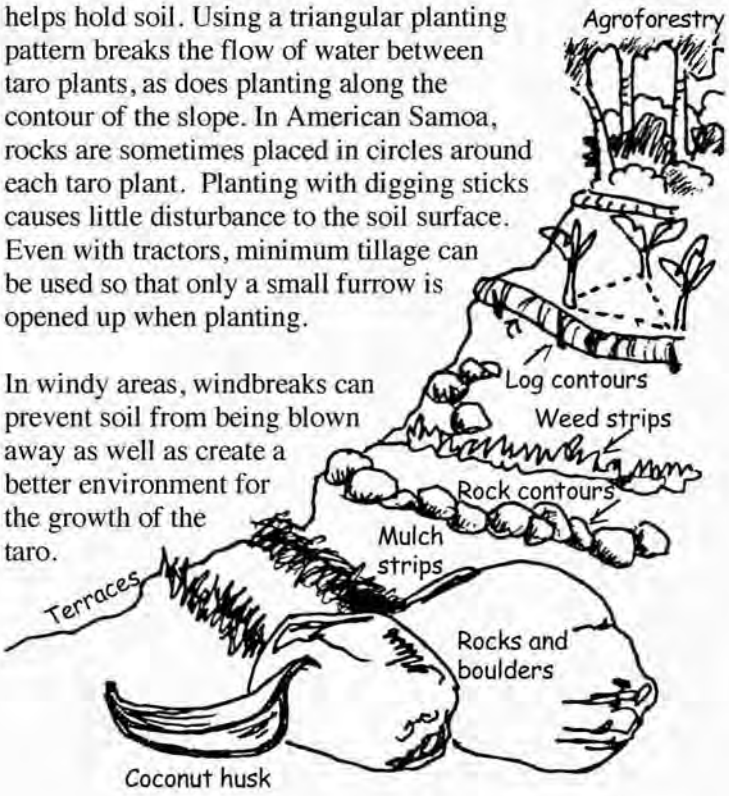
Introduction

In the Pacific Islands, taro has always been richly woven into the fabric of life. In 1989, the US Department of Agriculture's Low-Input Sustainable Agriculture Program funded a study of taro production systems in the American-affiliated Pacific Islands. The primary purpose of the study was to document and test traditional or current methods of crop protection, soil conservation, and maintenance of soil fertility. During the first year of the project interviews and surveys were conducted in American Samoa, Hawai`i (the Big Island), Guam, the Northern Mariana Islands, Palau, Yap, Ulithi, and Pohnpei. Insect, weed, and disease checklists were compiled, as well as informal interviews of farmers, wholesalers, retailers, and others. This handbook summarizes the information that was gathered and supplements a videotape entitled, "Nourish the Roots, Gather the Leaves." Reports of each island's survey were published as *Taro Production Systems in Micronesia, Hawai`i, and American Samoa*. Proceedings from the September 1992 conference, "Sustainable Taro Culture in the Pacific Islands," are available, as well as the results of further experiments testing some methods of taro production. For information on these publications, concact the ADAP Home Office.

Larger terraces built into slopes create flat steps. In wetland taro, water is channeled from terrace to terrace. These taro patches act as traps for silt that would otherwise flow downstream into the ocean. Diversion ditches can also be created across slopes to channel water away from fields when there are heavy rains. In low-lying areas near the ocean in Palau, berms are used to prevent erosion caused by high tides. Plantings on dikes between wetland terraces provide food, medicine, mulch, and green manure, and they stabilize the dikes as well.

When clearing land, trees can be left in the steepest areas and upslope from fields. In the fields themselves, tree trunks are left so the web of their roots helps hold soil. Using a triangular planting pattern breaks the flow of water between taro plants, as does planting along the contour of the slope. In American Samoa, rocks are sometimes placed in circles around each taro plant. Planting with digging sticks causes little disturbance to the soil surface. Even with tractors, minimum tillage can be used so that only a small furrow is opened up when planting.

In windy areas, windbreaks can prevent soil from being blown away as well as create a better environment for the growth of the taro.

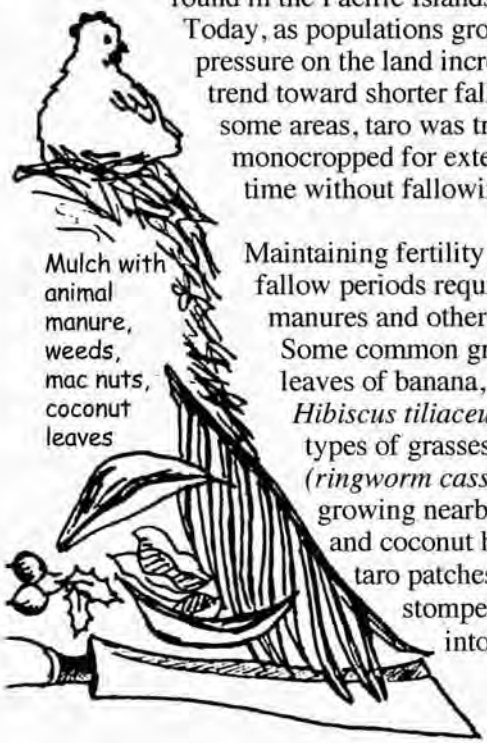


Soil Fertility

Despite their small land areas, the Pacific Islands have sustained taro production over the centuries by using only locally available resources to maintain soil fertility.

Agroforests of bananas, yams, kava/*awa* (*Piper methysticum*), breadfruit, and coconut grow up around taro plantings. Roots of these crops gather nutrients from different areas of the soil profile. As the canopy fills in the spaces between the trees, less light is available for lower-canopy crops, and taro production is rotated to recently cleared areas. In these areas, soil fertility builds up during the fallow period. Tree roots tap nutrients from deep zones of the soil, and tree leaves fall to the forest floor where leaf-mulch accumulates and decays. Fallows of grass, legumes, and weeds are also commonly found in the Pacific Islands.

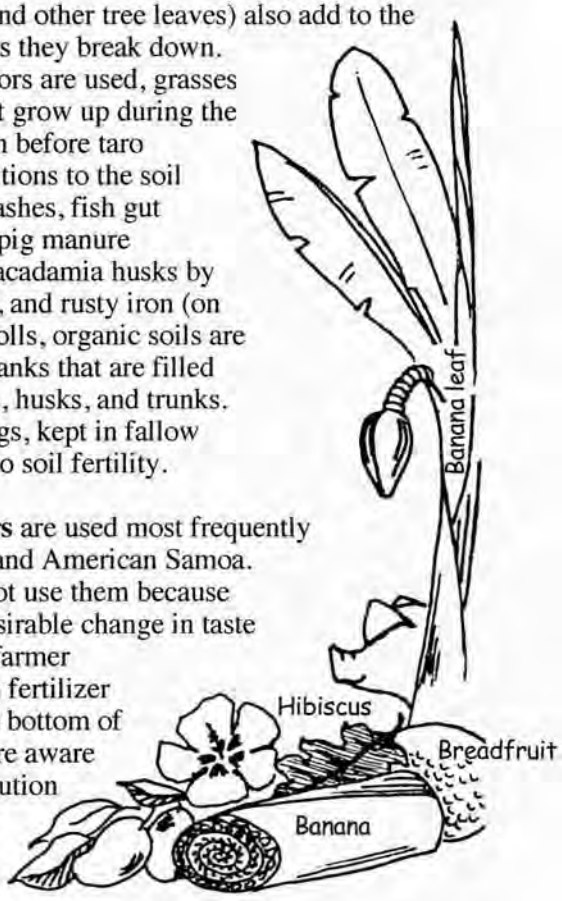
Today, as populations grow and development pressure on the land increases, there is a trend toward shorter fallow periods. In some areas, taro was traditionally monocropped for extended periods of time without fallowing.



Maintaining fertility with shorter or no fallow periods requires adding green manures and other soil amendments. Some common green manures are leaves of banana, croton, mango, *Hibiscus tiliaceus*, panax, different types of grasses, *Cassia alata (ringworm cassia)*, forest trees growing nearby, slashed weeds, and coconut husks. In wetland taro patches green manures are stomped or turned by hand into the thick mud.

Nitrogen-fixing plants have bacteria that live symbiotically (the intimate living together of two dissimilar organisms in a mutually beneficial relationship) on their roots, giving the plants the ability to use nitrogen from the air rather than just from the soil. In American Samoa a nitrogen-fixing species of *Erythrina*, commonly called *gatae*, is interplanted with taro and is left in fields during fallow periods. Loppings from the *gatae* are placed around the taro plantings. In Guam, our survey teams saw kudzu used in taro fields.

Mulches that prevent soil erosion and shade out weeds (coconut frond husks and mats, banana, cut grasses or weeds, breadfruit, and other tree leaves) also add to the fertility of the soil as they break down. In areas where tractors are used, grasses and other plants that grow up during the fallow are plowed in before taro planting. Other additions to the soil sometimes include ashes, fish gut soup, goat manure, pig manure (composted with macadamia husks by one Hawaii farmer), and rusty iron (on Asor, Ulithi). On atolls, organic soils are created in pits and tanks that are filled with coconut fronds, husks, and trunks. Animals, such as pigs, kept in fallow fields can also add to soil fertility.

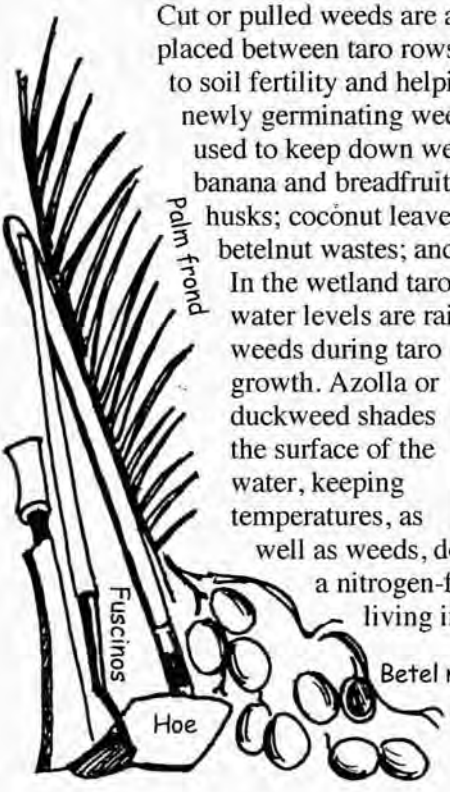


Chemical fertilizers are used most frequently in Hawai`i, Guam, and American Samoa. Some growers do not use them because they notice an undesirable change in taste of the corms. One farmer noted that too much fertilizer can cause rot on the bottom of the corms. Others are aware of the potential pollution problems in ground water and surface waters.

Weed Management

Every taro grower knows that weeding is a labor-intensive job that can become the major cost of production. Crops can be lost to weeds as other duties or outside employment draw people away from tending their taro.

Hand-weeding has been a family task everywhere in the Pacific and is still the most common method of weed control. In some places children and women do most of the weeding. Today machetes and sickles are used to cut weeds, leaving roots intact to prevent soil erosion. Other tools include hoes, picks, and the *fuscinos* (a hoe made originally from whaling tools in Guam).



Cut or pulled weeds are allowed to dry and placed between taro rows as mulch, adding to soil fertility and helping to shade out newly germinating weeds. Other mulches used to keep down weeds include leaves of banana and breadfruit; macadamia nut husks; coconut leaves, husks, and old mats; betelnut wastes; and cardboard.

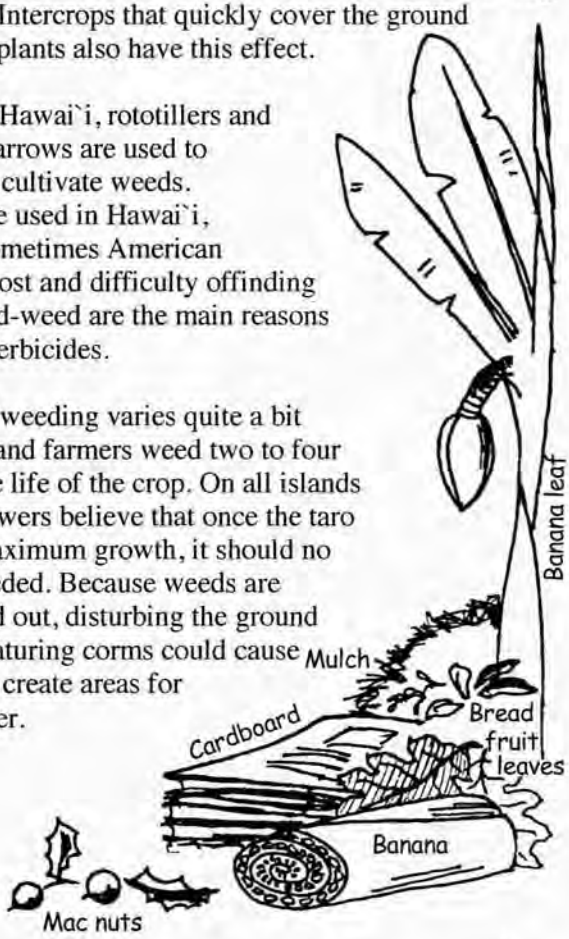
In the wetland taro patches of Hawaii water levels are raised to drown weeds during taro growth. Azolla or duckweed shades the surface of the water, keeping temperatures, as well as weeds, down. In addition, a nitrogen-fixing blue-green algae living in azolla leaves

can provide a large amount of nitrogen to crops. Weeds are pushed into the mud in wetland patches and added to planting beds in dryland taro, but they can cause disease problems.

Some taro varieties grow faster in the beginning than others, giving them a better ability to shade out weeds. Spacing taro plants closer together (in Guam, 2 feet by 2 feet (.6 meter by .6 meter) and in Hawai`i, 1 foot by 3 feet (.3 meter by .9 meter)) also helps shade the area between plants faster, decreasing the light that can reach weeds, thereby decreasing their growth. Intercrops that quickly cover the ground between taro plants also have this effect.

In Guam and Hawai`i, rototillers and springtooth harrows are used to mechanically cultivate weeds. Herbicides are used in Hawai`i, Guam, and sometimes American Samoa. The cost and difficulty offinding people to hand-weed are the main reasons farmers use herbicides.

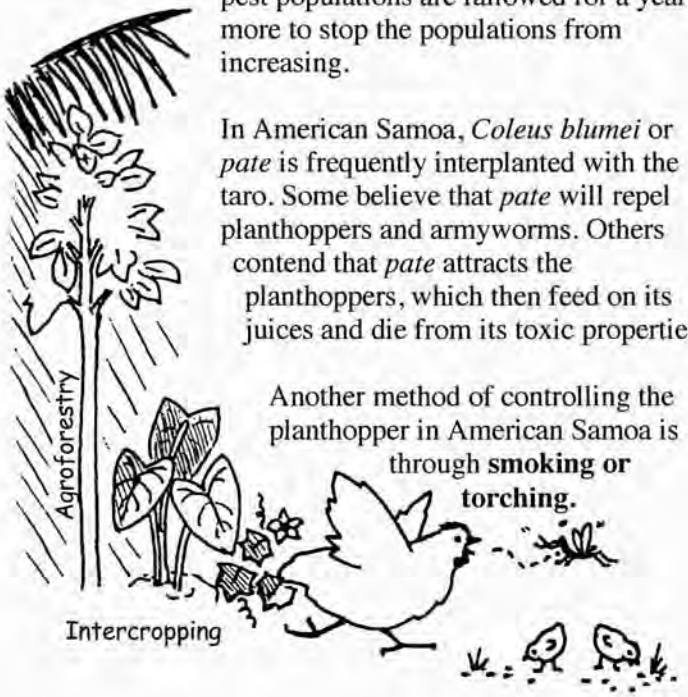
Frequency of weeding varies quite a bit but most dryland farmers weed two to four times over the life of the crop. On all islands surveyed, growers believe that once the taro reaches its maximum growth, it should no longer be weeded. Because weeds are mostly shaded out, disturbing the ground around the maturing corms could cause them harm or create areas for disease to enter.



Insect Management

The most common pests of taro in the areas surveyed were planthoppers, rose beetles, aphids, hornworms, and armyworms.

Agroforestry and **intercropping** can slow the spread of pests by creating a confusion of smells, making it more difficult for pests to find the taro growing amidst other plants. Taller crops and trees can create barriers that are hard to get beyond. Predator populations prefer habitats of mixed crops rather than monocropped fields. Predators of taro pests help keep populations low by parasitizing eggs or eating pests. By **rotating crops** grown in a field and moving taro to another area, insect populations that depend on taro to survive will not have the opportunity to build up to unmanageable numbers. In some areas, fields that have large pest populations are fallowed for a year or more to stop the populations from increasing.

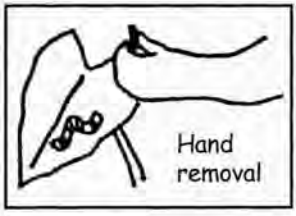


In American Samoa, *Coleus blumei* or *pate* is frequently interplanted with the taro. Some believe that *pate* will repel planthoppers and armyworms. Others contend that *pate* attracts the planthoppers, which then feed on its juices and die from its toxic properties.

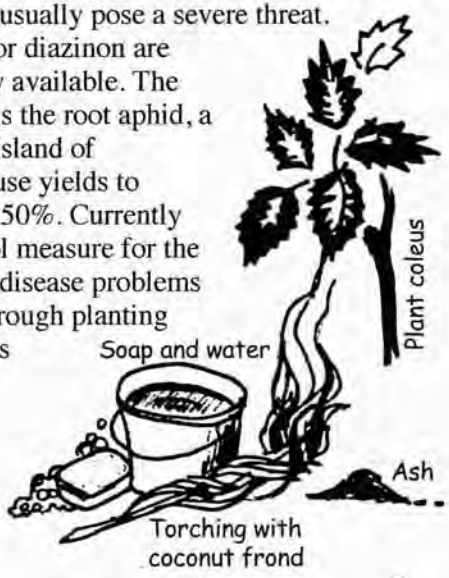
Another method of controlling the planthopper in American Samoa is through **smoking or torching.**

Coconut leaves are bundled, then set afire and carried through the fields, causing the planthoppers to jump off the plant. It is believed that the planthoppers die as their wings get burned, or that the smoke drives them away from the field in large numbers. This practice is done three times a week until all the planthoppers are gone. The smoking method is sometimes thought to be effective against the armyworm as well.

Armyworms or armyworm egg masses are smashed or handpicked and sometimes burned. Chickens are often brought in or raised around the plantation because they reportedly pick the armyworms from the plants. The scratching and feeding of the chickens around the base of plants was cited as a good weed control method as well as a way of aerating the soil.



Soap solution is sometimes applied to taro to decrease leaf aphid populations. In general, few insecticides are used because insects do not usually pose a severe threat. Sometimes malathion or diazinon are used, if they are legally available. The most damaging insect is the root aphid, a fairly new pest on the Island of Hawai`i, which can cause yields to decrease by more than 50%. Currently there is no good control measure for the root aphid. Insect and disease problems can easily be spread through planting material, so quarantines should be strictly followed.



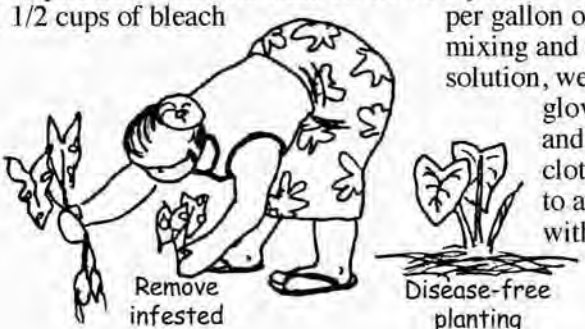
Disease Management

Protecting taro crops from disease is the most difficult task facing the grower. Both corm rots and leaf blights can severely decrease yields, in some cases destroying an entire crop. Some common diseases of taro leaves include *Phytophthora* leaf blight, ghost spot, southern blight, and dasheen mosaic virus. The most common corm rot is *Pythium*.

Fields that have suffered severe disease infestations can be fallowed from one to four years. Without the taro host plant to live on, some disease organisms cannot survive. If the disease has other hosts (such as *Phytophthora* leaf blight on banana), they must also be removed. Crop rotation, or growing crops other than taro, can have the same effect.

Some growers believe that taro grown in soils with high fertility and high levels of organic matter is less likely to suffer from disease problems. In Palau ash and coral lime are added to the soil. In Hawai`i lime is added and some farmers apply extra potassium fertilizer, especially in the last half of the crop to prevent *Pythium* corm rot and *loliloli*, a hardening of certain areas of the corm, which occurs in over-mature taro.

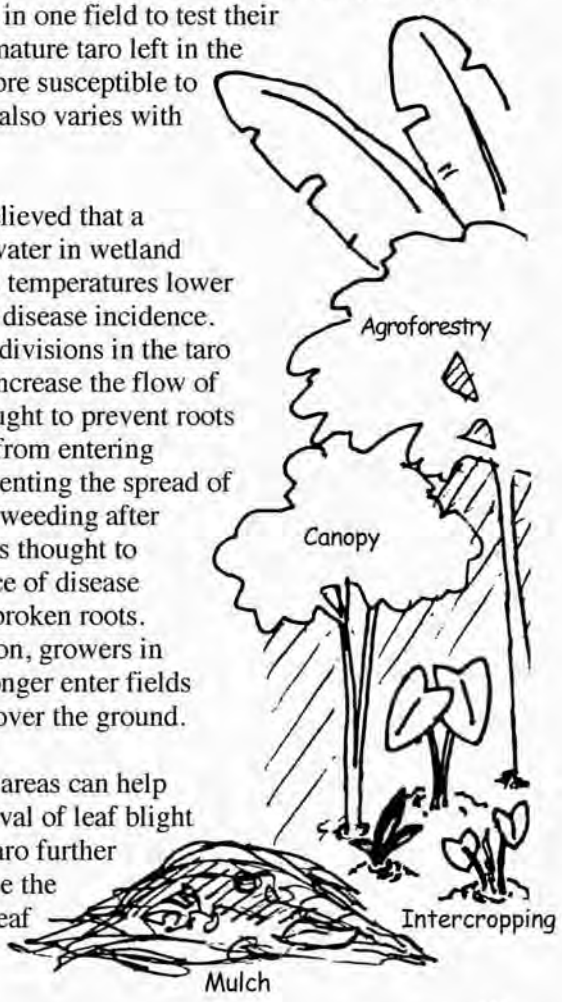
Farmers understand the importance of using clean planting material. Corm rots are easily spread to other fields with diseased planting material. To ensure that no diseases are being spread to new plantings, some growers use a general-purpose cleaning solution. A 10% diluted bleach solution is made by adding 1 part of liquid household chlorine bleach to 9 parts of water (just over 1 1/2 cups of bleach per gallon of water). When mixing and using bleach solution, wear rubber gloves, eye shield, and other protective clothing as needed to avoid contact with the bleach.



Diseased plants should be removed from the field when they are noticed. In Palau, the diseased plants are sometimes buried. In Pohnepi, leaves infected with blight are removed from the field and sometimes burned. In cases of severe infestations, all the leaves may be removed from all the plants. Some farmers believe that leaf blight is worse in certain seasons and they adjust planting times to avoid growing taro during those periods. Certain varieties are believed to be more resistant to disease than others. Growers in Palau will plant different varieties in one field to test their resistance. Over-mature taro left in the field is usually more susceptible to corm rot, but this also varies with the cultivar.

In Hawai`i it is believed that a constant flow of water in wetland taro will keep soil temperatures lower and thus decrease disease incidence. Furrows between divisions in the taro patches in Palau increase the flow of water and are thought to prevent roots from one section from entering another, thus preventing the spread of disease. In Palau, weeding after spreading mulch is thought to increase the chance of disease entering through broken roots. For the same reason, growers in many places no longer enter fields after taro plants cover the ground.

Planting in sunny areas can help decrease the survival of leaf blight spores. Planting taro further apart may decrease the rate of spread of leaf blight.

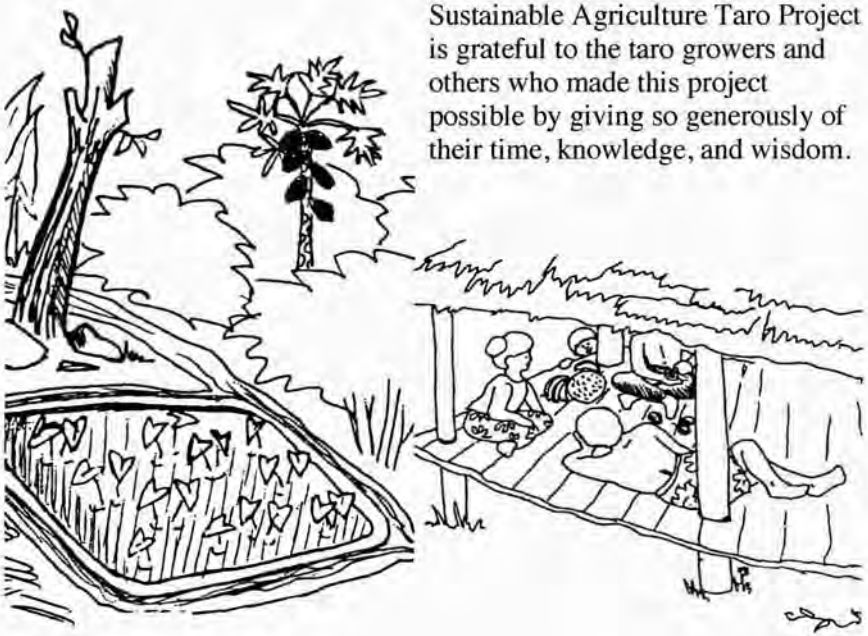


Conclusions

The challenge before us is to combine the best of the old and the new methods of growing taro in ways that are culturally appropriate as well as environmentally and economically sound. The continued exchange of information among farmers and other agricultural workers may make the way easier to find. We hope that our booklet makes a small contribution to this exchange and encourages others to continue their efforts.

Thank you

The Taro Production Systems in the American Pacific, Low-Input Sustainable Agriculture Taro Project is grateful to the taro growers and others who made this project possible by giving so generously of their time, knowledge, and wisdom.



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The information contained in this booklet was gathered from taro growers in interviews and surveys conducted in 1989–1990 on seven island groups in the American-affiliated Pacific. It is a summary of common practices in use by those farmers.

LISA/Taro Project Researchers

American Samoa	Agnes Vargo and Fuifui Taotua
Guam	Harley Manner, Ilse Schreiner, Frank Cruz, and John Brown
Hawai`i	Dwight Sato and Lisa Ferentinos
Northern	MarianasLolita Ragus, Hardy Richards, and Isidoro Cabrera
Palau	Meresbang Ngiralmau and Robert Bishop
Pohnpei	William Raynor
Yap	Marjorie Falanruw

This booklet was compiled by Lisa Ferentinos based on reports prepared by these researchers.

Updated by Kristie Tsuda
June 2000
Cover graphic by Miles Hakoda, College of Tropical Agriculture and Human Resources, University of Hawai`i
Illustrations by Penny Levin

Publication was supported in part by a grant from the USDA/CSRS Sustainable Agriculture Research and Education Program (formerly called LISA). Support was also provided by American Samoa Community College, College of Micronesia, Northern Marianas College, University of Guam, and University of Hawai`i under the auspices of the Agricultural Development in the American Pacific (ADAP) Project.

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Agricultural Development in the American Pacific (ADAP) Project
3050 Maile Way, Gilmore 213
College of Tropical Agriculture and Human Resources
University of Hawai`i at Maona
Honolulu, HI 96822 USA
Fax 808-956-6967
adap@hawaii.edu

American Samoa Community College • 684.699.1575 • fax 684.699.5011
College of Micronesia • 691.320.2462 • fax 691.320.2726
College of Micronesia (FSM) • 691.320.2480 • fax 691.320.2479
College of the Marshall Islands • 692.625.3236 • fax 692.625.4699
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University of Guam • 671.735.2002 • fax 671.734.5600
University of Hawai`i • 808.956.8140 • fax 808.956.6967

Funded by the United States Department of Agriculture
Cooperative State Research, Education, and Extension Service Grant 99-38826-7854
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